CHAPTER IV

FORECAST TECHNIQUES

A. GENERAL

The question, "How do you forecast typhoons?", is frequently asked by personnel who make operational decisions based on our warnings, as well as by meteorologists who have had little or no experience in tropical cyclone forecasting. The simplest answer is that all pertinent data, including that gleaned from current and prognostic surface and upper air charts and differential analyses, is combined subjectively to produce each warning. This would indicate that the art of tropical forecasting is perhaps less advanced than the art of forcasting in temperate or northern latitudes.

After the initial detection of a tropical cyclone, the forecast problems are: direction of movement, speed of movement, intensification, and weakening. In the case of weakening, the problem usually relates to whether the cyclone will weaken and become extratropical, or weaken and dissipate.

As a tool in preparing our forecasts, a basic chart (from the Pacific Airways Plotting Chart series) plus 3 acetate overlays are used. All fixes are plotted on the basic chart. Twenty-four hour forecast positions are plotted on the bottom overlay, warning positions (later modified when necessary) are plotted on the second overlay, and the top overlay is utilized as a work sheet.

B. FORECASTING MOVEMENT

Once a tropical cyclone has been detected, the first step in preparing to issue the initial warning is to lay out a track based on climatology. This track is laid out on the top acetate so as to extend 4 or 5 days at the speed indicated by climatology. Next, the track is modified in accordance with the existing and forecast upper air pattern, after which the initial warning is prepared and issued. The forecast track is extended and modified with time, as reconnaissance fixes are received and the upper air pattern changes.

Once a typhoon has reached typhoon intensity, reconnaissance fixes are the primary data used in preparing forecasts for the subsequent 24 hours. At this stage of development, prior reconnaissance fixes have usually established a fairly well-defined track, and acceleration or deceleration trends can be determined from an evaluation of the fixes received during the previous 24 hours.

Used as supplementary tools in preparing the 12 and 24 hour forecasts are the Miller-Moore objective method, surface and upper air analyses and prognoses, differential analyses, and height and pressure change charts.

Forecasts for the second 24 hour period (the 48 hour forecast), for which we admittedly have a low level of skill, are based to a large degree on upper air prognoses and differential analyses.

The large triangle formed by Guam, Manila and Tokyo describes the preferred area for tropical cyclone recurvature. The sparsity of upper air data in this area frequently precludes accurate analyses. This of course makes it extremely difficult to determine, within desirable limits of accuracy, the latitude of recurvature, or the shape of the recurvature pattern. The single and double 500 mb space mean charts are sometimes an aid in determining the forecast direction of movement of a typhoon during the critical period of recurvature.

After recurvature, a typhoon or tropical storm behaves in a manner similar to an extratropical cyclone regarding movement, and it is therefore necessary to carefully consider the movement, slope and change in shape of the major upper air systems during this period. After recurvature, reconnaissance fixes continue to be the most important forecasting tool. In addition, the 500 mb double space mean plus M2 field has been found to be very useful.

As typhoons approach land masses, direction of movement is frequently modified. At times, ridging develops between the typhoon and terrain and, in the case of Japan, this causes a typhoon S of Japan and moving to the NE, to move slightly more easterly. Typhoons approaching and passing over Taiwan undergo complex changes in movement, configuration and intensity.

C. INTENSIFICATION AND WEAKENING

Those tropical cyclones which subsequently reach typhoon intensity, usually intensify from a tropical depression, with surface winds of 20 to 25 kts, to typhoon strength in a period of about 3 days. The development of wall clouds appears to be the critical factor involved. A tropical cyclone frequently develops to storm intensity with a fairly haphazard cloud pattern, i.e., no well developed spiral bands exist, and unstable clouds are frequently found near the center but are not organized.

The key to intensification to typhoon strength appears to be the organization of a wall cloud system along with spiral bands. Once this occurs, the cyclone appears to be an energy generator, and is limited in intensity only by the raw material source (warm moist air from over an extensive warm water surface) and by the ability of the external environment to dispose of this energy.

Forecasting changes in intensity is accomplished by use of reconnaissance observations to determine existing conditions, followed by an evaluation of the high level pattern to determine whether intensification or weakening is indicated. Needless to say, the passage of a typhoon over a large land mass or cold water, or the transport of cold air in the lower levels into a typhoon circulation, will cause the system to weaken. The typical sequence of intensification - weakening is essentially as follows: intensification to typhoon strength, continued intensification until recurvature is completed, then slow weakening as the system passes through a less favorable environment until it becomes extratropical.